



BROOKHAVEN
NATIONAL LABORATORY

BNL-9 RUN

FINAL REPORT

Marcelo E. Vazquez
Medical Department
NASA-BNL Liaison Scientist
BNL/NASA webpage:
<http://www.bnl.gov/medical/NASA/NASA-home%20frame.htm>

December 2003

TABLE OF CONTENTS

Executive Summary	3
BNL-9 Proposals/SACR Review	4
Participants	5
Participants Statistics	7
Participants Institutions	8
Iron Run Dates/Beam Time Description	9
Silicon Run Dates/Beam Time Description	10
Total BNL-9 Run Dates/Beam Time Description	11
Descriptive Statistics	12
Beam Characteristics	15
Run Statistics and Incidents	16
Experimenters and Run Statistics	18
Participants, Experimental Samples and Endpoints	19
List of Personnel	21

EXECUTIVE SUMMARY

During the fall of 2002 a series of radiobiological and physics experiments were performed using the BNL's Alternating Gradient Synchrotron to accelerate iron ion beams (Experiment 960, BNL-9). These experiments were part of the ninth consecutive run sponsored by NASA's Space Radiation Health Program (SRHP) heavy ion radiobiology research program at BNL.

A total of 28 proposals were approved to participate in the BNL-9 run, 10 of which was a renewal, 9 were continuing projects and 9 which were new proposals. Six groups (six proposals) were not able to participate during BNL-9. Only one piggyback experiment was approved for BNL-9. Therefore, 22 groups affiliated to fourteen institutions from the United States and 4 from foreign countries (Italy and Japan) were represented, totaling 86 users.

More than 2000 biological samples were irradiated at the AGS A-3 beam line, employing 184.5 hours of beam time (48 hours for in vivo studies and 73 hours for in vitro studies). In addition, 25 hours were used for physics experiments, and a total of 38.5 hours were necessary for beam characterization, tuning, dosimetry, and calibration. A total of 28.5 hours of beam time were lost (15.4%) due to accelerator or power supply related problems.

During BNL-9, AGS provided iron (1.046 GeV/nucleon, LET: 148 keV/ μm and 5 GeV/n, LET beams and Si (0.6 GeV/n, LET: 49.5 keV/ μm) for biology and physics experiments. The dose/rates used were as low as 10 cGy/min and as high as 15 Gy/min. The spill rate employed was 30 spills/min with a duration of 500-600 msec/spill. The spill fluence was (particles/spill) 1×10^8 (max) and 1.5×10^5 (min). The intensities (particles/ cm^2/sec on target) used during the run were 1×10^8 (max) and 400 (min). A 7.5-cm diameter beam spot was employed as a nominal spot for the majority of the exposures. For larger samples (animals), an elliptical spot was used (up to 9 cm).

Tandem-Booster set-up started on November 4 with the transport and circulation of Fe beams at the AGS complex. Beam was tuned into cave on November 5. 5 GeV/n Fe ion beams were available for tuning on November 6. The next several shifts were spent on tuning into the target area, beam diagnostics and establishing several different combinations of beam intensities and spot shapes and sizes for physics and biology runs. Physics studies started on the morning of October 7 as planned. Biology studies started on the morning of November 8 (A. Kennedy, Penn. U.) and proceeded through November 10. Late on the same day, AGS tuned 1GeV/n iron beams for physics studies for 9 hours. Biology studies started on November 11 (L. Green, LLUMC) and continued until early November 15. On November 15 (0200AM) AGS started tuning Si ions 0.6 GeV/n for biology studies (Gewirtz, Penn. U.) running until early morning on November 16. BNL-9 officially ended at 0400AM, November 16, 2002.

Radiobiological experiments employed cells, tissues, and intact specimens, which required a complex coordination and planning of their respective logistic support. Biological studies used human, mouse, rat and hamster cell lines, human-hamster hybrid cell lines, tumor cell lines and intact specimens (rodents and fish). Physics experiments involved the exposure of solid state detectors and spacecraft materials. The full program was completed in 9 days.

BNL-9 Projects Reviewed by the BNL's Scientific Advisory Committee in Radiobiology (SACR):

Project	P.I.	Status	Funding Source	BNL-9 Participation
B-1	Zeitlin/Miller	Renewal	NASA	Yes
B-3	Cucinotta/Wu	Renewal	NASA	Yes
B-7	Rabin	Renewal	NASA	Yes
B-10	Chang	Renewal	NASA	No
B-19	Kronenberg	Renewal	NASA	No
B-44	Durante	Renewal	ASI	Yes
B-45	Setlow	Renewal	NASA	Yes
B-51	Murnane	Renewal	NASA	Yes
B-52	Gerwitz	Renewal	NSBRI	Yes
B-53	Lupton	Renewal	NSBRI	Yes
B-54	Kennedy	Continuing	NSBRI	Yes
B-57	Koniarek	Continuing	Piggyback	Yes
B-58	Chen	Continuing	NASA	No
B-62	Obenaus	Continuing	NASA	Yes
B-63	Nelson	Continuing	NASA	Yes
B-64	Vazquez	Continuing	NSBRI	Yes
B-65	Vazquez	Continuing	NSBRI	Yes
B-66	Narici	Continuing	ASI	No
B-67	Blakely	Continuing	NASA	No
B-68	Hall/Worgul	New	NASA	Yes
B-69	Nelson	New	NASA	Yes
B-70	Barcellos_Hoff	New	NASA	No
B-71	Burns	New	NASA	Yes
B-72	Gonda	New	NASA	Yes
B-73	Sutherland	New	DOE/NASA	Yes
B-74	Chatterjee	New	NASA	Yes
B-75	Ford	New	DOE/NASA	Yes
B-76	Green	New	DOE/NASA	Yes

BNL-9 PARTICIPANTS

Exp.	Participants	Affiliation	Title
B-1	C. Zeitlin. J. Miller L. Heilbronn R.P. Sigh W. Holley W. Schimmerling	Lawrence Berkeley National Laboratory, CA " " " " NASA, HDQ, DC	Ph.D., Principal Investigator Ph.D., Co-Principal Investigator Ph.D., Co-Worker Ph.D., Co-Worker Ph.D., Co-Worker Ph.D., Co-Worker
B-3	F. Cucinotta* H. Wu P. Sagamti K. George V. Willingham	NASA, Johnson Space Center, TX " " " "	Ph.D., Principal Investigator Ph.D., CoPrincipal Investigator Ph.D., Co-Worker Senior Research Associate BS, Co-Worker
B-7	B. Rabin J. Joseph B. Sukitt-Hale J. McEwen S. Szprengiel D. Jenkins A. Eggleston	University of Maryland, Baltimore County, MD Human Nutrition Research Center on Aging, MA " " " "	Ph.D., Principal Investigator Ph.D., Co-Principal Investigator Co-Worker Co-Worker Co-Worker Co-Worker
B-44	M. Durante* M. Belli G. Simone P. Scampoli G. Grossi	University "Federico II", Napoli, Italy National Institute of Health, Rome, Italy " " University "Federico II", Napoli, Italy	Ph.D., Principal Investigator Ph.D., Co-Worker Ph.D., Co-Worker Ph.D., Co-Worker Ph.D., Co-Worker
B-45	R. Setlow J. Jardine A. Shima	Brookhaven National Laboratory, NY " University of Tokyo, Japan	Ph.D., Principal Investigator BS, Co-Worker Ph.D., Co-Worker
B-51	J. Murnane* B. Fouladi R. Eltanal	University of California, San Francisco, CA " "	Ph.D., Principal Investigator Ph.D., Co-Worker BS, Co-Worker
B-52	J. Gerwitz* B. Sutherland P. Bennett J. Sutherland P. Guida J. Trunk D. Monteleone	NSBRI, University of Pennsylvania Brookhaven National Laboratory, NY " " " " "	Ph.D., Principal Investigator Ph.D., Co-Investigator MS., Biology Associate. Ph.D., Co-Worker Ph.D., Co-Worker Co-Worker Co-Worker
B-53	J. Lupton* L. Braby N. Turner S. Taddeo N. Popovic M. Young Hong C. Henderson L. Sanders J. Ford	NSBRI, Texas A&M University, TX " " " " " " " "	Ph.D., Principal Investigator Ph.D., Co-Investigator Ph.D., Co-Investigator Co-Worker Co-Worker Co-Worker Co-Worker BS, Co-Worker Ph.D., Co-Worker
B-54	A. Kennedy S. Wan J. Ware J. Donahue M. Stanislaus	NSBRI, University of Pennsylvania " " " "	Ph.D., Principal Investigator Ph.D., Co-Investigator Ph.D., Co-Investigator Ph.D., Co-Investigator Ph.D., Co-Investigator

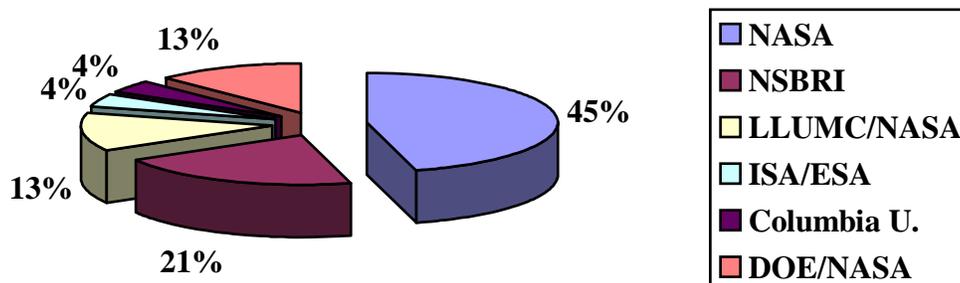
B-57	J. Koniarek M. Vazquez	Columbia University, New York, NY Brookhaven National Laboratory, NY	Ph.D., Principal Investigator Ph.D., MD, Co-Worker.
B-62	A. Obenaus W. Kennedy T. Loring Meir	Loma Linda University “ “	Ph.D., Principal Investigator Ph.D., Co-Worker Ph.D., Co-Worker
B-63	G. Nelson M. Pecaut A. Smith S. Jones S. Rainer	Loma Linda University “ “ “ “	Ph.D., Principal Investigator Ph.D., Co-Worker BS, Co-Worker BS, Co-Worker BS, Co-Worker
B-64	M. Vazquez L. Estevez S. Otto O. Thomas	NSBRI, Brookhaven National Laboratory, NY “ “ “	MD, Ph.D., Principal Invest. BS, Co-Worker BS, Co-Worker. BS, Co-Worker
B-65	M. Vazquez O. Thomas M. Bruneus A. Billups S. Koslovsky	NSBRI, Brookhaven National Laboratory, NY “ “ “ “	MD, Ph.D., Principal Invest. BS, Co-Worker BS, Co-Worker. Undergrad-Student Undergrad-Student
B-68	E. Hall* B. Worgul M. Vazquez S. Otto	CRR, Columbia University, NY ERERL, Columbia University, NY Brookhaven National Laboratory, NY “	Ph.D., Principal Investigator Ph.D., Co-Principal MD, Ph.D., Co-Worker BS, Co-Worker.
B-69	G. Nelson M. Pecaut A. Smith S. Jones	Loma Linda University “ “ “	Ph.D., Principal Investigator Ph.D., Co-Worker BS, Co-Worker BS, Co-Worker
B-71	F. Burns J. Xu	New York University Medical Center, NY “	Ph.D., Principal Investigator Co-Worker
B-72	S. Gonda	NASA, Johnson Space Center, TX	Ph.D., Principal Investigator
B-73	B. Sutherland P. Bennett J. Sutherland M. Hada J. Trunk D. Monteleone	Brookhaven National Laboratory, NY “ ” ” ” ”	Ph.D., Principal Investigator MS., Biology Associate. Ph.D., Co-Worker Ph.D., Co-Worker Co-Worker Co-Worker
B-74	A. Chatterjee* P. Wilson	Lawrence Berkeley National Laboratory, CA	Ph.D., Principal Investigator Co-Worker
B-75	J. Ford L. Braby T. Good A. Houck	Texas A&M University, TX “ “ “	Ph.D., Principal Investigator Ph.D., Co-Investigator Co-Worker Co-Worker
B-76	L. Green B. Bianski	Loma Linda University “	Ph.D., Principal Investigator Co-Worker

*Not present during the actual run

BNL-9 PARTICIPANTS STATISTICS

PARTICIPANTS	BNL-9
Ph.D., Principal Investigators	24
M.D., Ph.D., Principal Investigators	1
Ph.D., Co-Principal Investigators	4
Ph.D., Co-Investigator	8
Co-Workers	17
Ph.D.	17
B.S.	11
MS Biology Associate	1
Senior Research Associates	1
Undergraduate Student	2
Total:	86

RESEARCH PROJECT SPONSORS:



PARTICIPANT INSTITUTIONS

NASA related centers/institutes (3)

- NASA, Headquarters, DC
- NASA, Johnson Space Center, TX
- National Space Biomedical Research Institute, TX

National Laboratories/Institutes (3)

- Brookhaven National Laboratory, NY
- Lawrence Berkeley National Laboratory, CA
- Human Nutrition Research Center on Aging, MA

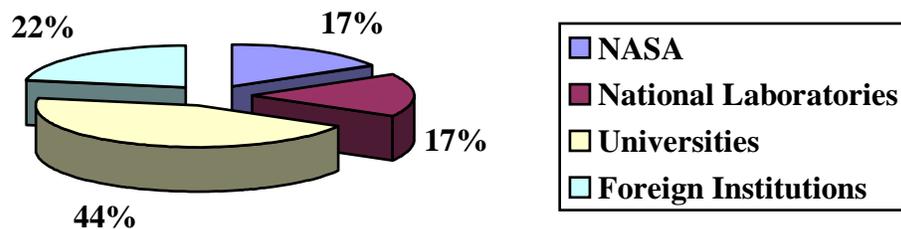
Universities (8)

- University of Maryland, Baltimore County, MD
- Columbia University, NY
- The University of Texas Health Sciences., TX
- New York University Medical Center, NY
- Loma Linda University, CA
- Texas A&M University, TX
- University of California, San Francisco, CA
- University of Pennsylvania, PA

Foreign Institutions (4)

- University of Rome, Thor Vergara, Italy
- University “Federico II”, Napoli, Italy
- National Institute of Health, Rome, Italy
- University of Tokyo, Japan

INSTITUTIONS STATISTICS:



BNL-9 IRON RUN DESCRIPTION

RUN DATES

Run dates	Scheduled		Actual	
	Date	Time	Date	Time
Run start	11/07	0700	11/07	0700
Run end	11/14	0600	11/15	0200
Tuned into cave	11/06	0900	11/06	0900
Beam delivered for Biology				
Fe 5 GeV/n	11/08	0600	11/08	0730
End run	11/10	0500	11/10	1600
Fe 1 GeV/n	11/10	2200	11/11	1100
End run	11/14	0730	11/15	0200
Beam delivered for Physics				
Fe 5 GeV/n	11/7	0700	11/7	0700
End run	11/7	2300	11/7	2300
Fe 1 GeV/n	11/10	1000	11/10	2300
End run	11/10	2200	11/11	0800

BEAM TIME DESCRIPTION (hours)

Total Clock Time	(from 11/07 0700 to 11/15 0200)		187
Total Beam-on Time			
5 GeV/n	79		
1 GeV/n	83.5		
Sub-total			162.5
Total Beam-off time			
5 GeV/n	7.5		
1 GeV/n	17		
Sub-total			24.5
Total			187.0
Beam Time for Biology			
5 GeV/n In Vitro Studies	30.5		
5 GeV/n In Vivo Studies	30		
Sub Totals		60.5	
1 GeV/n In Vivo Studies	18		
1 GeV/n In Vivo Studies	30		
Sub Totals		48	
Total			108.5
Beam Time for Physics			
5 GeV/n	16		
1 GeV/n	9		
Sub-total		25	
Total			25

(Continuation)			
Other			
5 GeV/n			
Tuning-Dosimetry	2.5		
NSRL Testing	7		
Beam Chracaterization	5		
Sub-total		14.5	
1 GeV/n			
Tuning-Dosimetry	14.5		
Sub-total		14.5	
Total			29
Grand Total			162.5

BNL-9 SILICON RUN DESCRIPTION

RUN DATES

Run dates	Scheduled		Actual	
	Date	Time	Date	Time
Run start	11/14	0730	11/15	0200
Run end	11/15	1000	11/16	0400
Tuned into cave	11/14	0730	11/15	0200
Beam delivered for Biology				
Si 0.6 GeV/n	11/14	1900	11/15	1000
End run	11/15	1000	11/16	0230
Beam delivered for beam testing				
Si 1 GeV/n			11/16	0230
End run			11/16	0400

BEAM TIME DESCRIPTION (hours)

Total Clock Time	(from 11/15 0200 to 11/16 0400)		26
Total Beam-on Time			
0.6 GeV/n	22		
Total Beam-off time			
0.6 GeV/n	4		
Total			26
Beam Time for Biology			
0.6 GeV/n In Vitro Studies	12.5		
0.6 GeV/n In Vivo Studies	0		
Sub Totals			12.5

(Continuation)			
Beam Time for Physics			
0.6 GeV/n	0		
Sub-total			0
Other			
0.6 GeV/n			
Tuning-Dosimetry	8		
NSRL Testing	1.5		
Beam Characterization	0		
Sub-total			9.5
Grand Total			22

BNL-9 FINAL RUN DATES

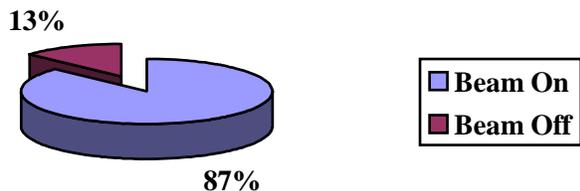
Run dates	Scheduled		Actual	
	Date	Time	Date	Time
Run start	11/07	0700	11/07	0700
Run end	11/15	1000	11/16	0400
Tuned into cave	11/06	0900	11/06	0900

TOTAL BNL-9 BEAM TIME DESCRIPTION (hours)

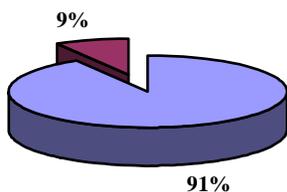
Total Clock Time	(from 11/07 0700 to 11/16 0400)		213
Total Beam-on Time			184.5
Total Beam-off time			28.5
Beam Time for Biology			
In Vivo Studies	48		
In Vitro Studies	73		
Beam Time for Physics	25		
Beam time for dosimetry, calibration, tuning, etc.	38.5		
Totals	184.5		213

DESCRIPTIVE STATISTICS

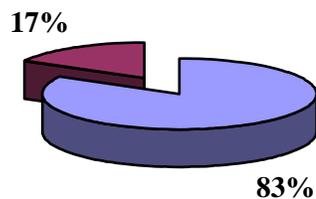
- **Fe Total Beam Availability**



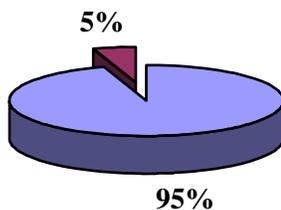
- **Fe 5 GeV/n**



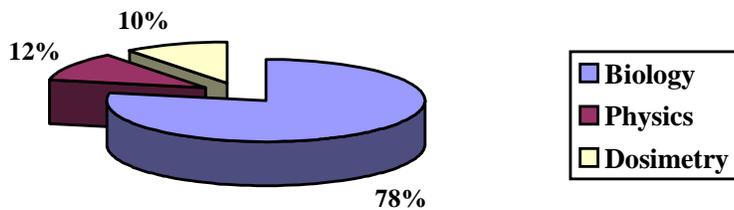
- **Fe 1 GeV/n**



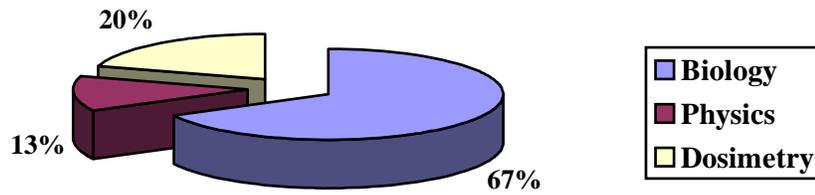
- **Si Total Beam Availability**



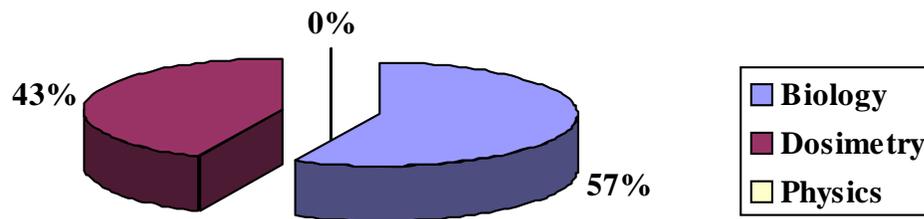
- **Fe 5 GeV/n Distribution of Beam Time Usage:**



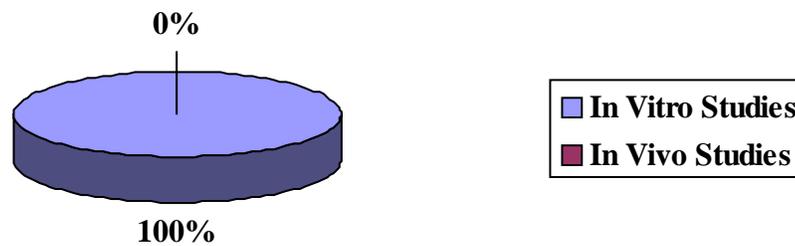
- **Fe 1 GeV/n Distribution of Beam Time Usage:**



- **Si 0.6 GeV/n Distribution of Beam Time Usage:**

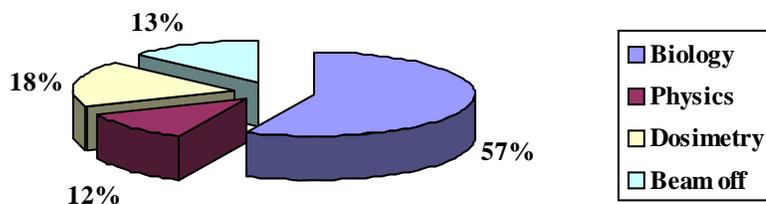


- **Si 0.6 GeV/n Distribution of Beam Time for Biology:**

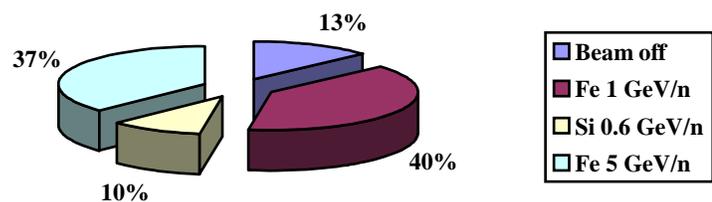


BNL-9 BEAM TIME SUMMARY

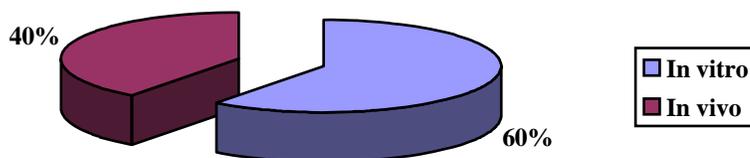
- **DISTRIBUTION OF BEAM TEAM USAGE:**



- **DISTRIBUTION OF BEAM TEAM BY SPECIES AND ENERGIES:**



- **DISTRIBUTION OF TOTAL BEAM TIME BY BIOLOGY EXPERIMENTS:**



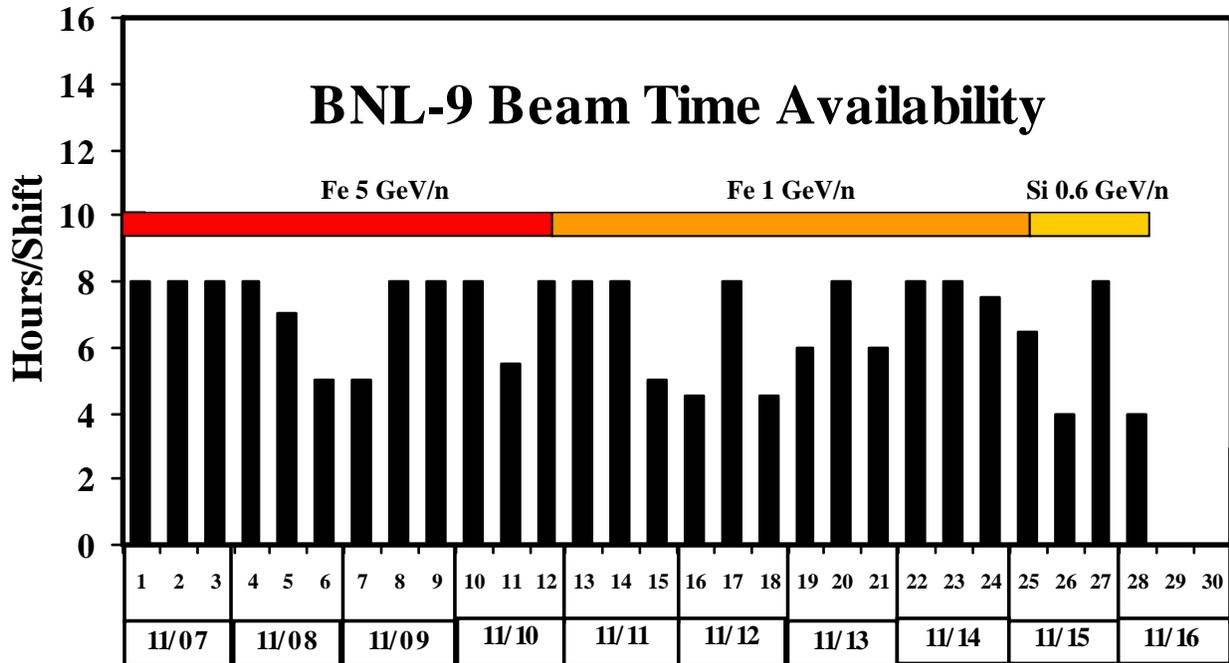
BEAM CHARACTERISTICS

	$^{56}\text{Fe}^{26}$		$^{28}\text{Si}^{14}$
	5000 MeV/n	1000 MeV/n	600 MeV/n
Fluence (particles/cm²/sec)			
Maximum on target	TBD	1 x 10⁸	TBD
Minimum on target	400	400	400
Spill rate (spills/min)	18	18	18
Spill length (msec)	500-600	500-600	500-600
Particles/spill			
Maximum	1 x 10⁸	1 x 10⁸	1 x 10⁸
Minimum	1.5 x 10⁵	1.5 x 10⁵	1.5 x 10⁵
Beam spot diameter (cm)	7.5	7.5 - 9	7.5
Beam cut off length.	<1%	<1%	<1%
Actual Energy (MeV/n)			
Extracted	TBD	1078	600
On Target	TBD	1046	585
Actual LET on Target (keV/μm)	143	148	49.5
Dose/rate recorded (cGy/min)			
Maximum	1500	1500	1000
Minimum	10	10	10
Minimum dose exposure (cGy)	5	0.1	TBD
No of hours for beam characterization, tuning and dosimetry	14.5	14.5	9.5

BNL-9 Run Statistics and Incidents

Date	Shift	HIP Avail.	Non-HIP*	Remarks
11/07/02	1	8	0	5 GeV Fe run start, dosimetry. Physics experiments
	2	8	0	Physics continues.
	3	8	0	Physic run end. BAF testing start.
11/08/02	4	8	0	Test completed. Dosimetry for biology start.
	5	7	1	Biology run start. Iris scan hardware problems.
	6	6	2	Same problems. High dose rate tuning.
11/09/02	7	6	2	Security system fault and beam control problems.
	8	8	0	Biology run continues. No incidents.
	9	8	0	Biology run continues. No incidents.
11/10/02	10	8	0	Biology run continues. No incidents.
	11	5.5	2.5	Power supply problems. Intensity lost, foil change.
	12	8	0	Switch to 1 GeV/n Fe, dosimetry, tuning low intensity
11/11/02	13	8	0	Physics run.
	14	8	0	Biology run start
	15	5	3	Intensity fluctuations. F6 septum trip-off
11/12/02	16	4.5	3.5	Beam drifting. Biology continues.
	17	8	0	No incidents
	18	4.5	3.5	Beam control problems. Vacuum valve problems
11/13/02	19	6	6	Septum off. Retuning.
	20	8	0	No incidents.
	21	6	2	Beam control lost.
11/14/02	22	8	0	No incidents.
	23	8	0	No incidents.
	24	7.5	0.5	Beam drifting.
11/15/02	25	6.5	1.5	Idem. Switch to 0.6 GeV/n Si for biology
	26	4	4	Booster problems.
	27	8	0	No incidents.
11/16/02	28	8	0	End BNL-9.
Totals:	28	196.5 hr. (84%)	31.5 hr. (16%)	

*Time loss due to machine or power supply problems, setting up operations.



Shift (from 11/07/02 to 11/16)

BNL-9 EXPERIMENTERS AND RUN STATISTICS

Exp. ID	Principal Investigator	Ion & Energy	Beam T. Approved	Beam T. Used	Dose Range (cGy)	Dose/Rate (cGy/min)	Number of Samples
B-1	Zeitlin	Fe, 5 GeV/n Fe, 1 GeV/n	16.0 12.0	16.0 8.0	NA	NA	NA
B-3	Cucinotta/Wu	Fe, 5 GeV/n Fe, 1 GeV/n	2.0 2.0	3.5 2.0	25 to 200	50 to 100	90
B-7	Rabin	Fe, 5 GeV/n Fe, 1 GeV/n	5.0 6.5	6.5 6.5	80 to 250 100 to 250	100 200	86 90
B-44	Durante	Fe, 5 GeV/n Fe, 1 GeV/n Si, 0.6 GeV/n	8.0 3.0	9.5 4.5 1.5	10 to 20000	10 & 1500	300
B-45	Setlow	Fe, 1 GeV/n	1.5	2.5	30 to 100	100	70
B-51	Murnane	Fe, 1 GeV/n	3.0	2.0	100 to 800	200	20
B-52	Gerwitz	Fe, 5 GeV/n Fe, 1 GeV/n Si, 0.6 GeV/n	2.5 2.5	3.5 5.0 5.0	35 to 200 35 to 200 NA	20 & 100 20 & 100 NA	100 100
B-53	Lupton	Fe, 1 GeV/n	6.5	5.0	100	100	75
B-54	Kennedy	Fe, 5 GeV/n Fe, 1 GeV/n Si, 0.6 GeV/n	12.0 2.0	10.0 0.0 3.0	5 to 200	10 to 100	200
B-57	Koniarek	Fe, 1 GeV/n	0.0	0.0	NA	NA	30
B-62	Obenaus	Fe, 5 GeV/n Fe, 1 GeV/n	7.0	5.5 2.0	100 to 400	100	110
B-63	Nelson	Fe, 5 GeV/n Fe, 1 GeV/n	1.0 2.0	3.5 2.5	200 & 1000	100-200	20 60
B-64	Vazquez	Fe, 1 GeV/n	6.5	6.0	15 to 240	50 to 150	200
B-65	Vazquez	Fe, 5 GeV/n Fe, 1 GeV/n Si, 0.6 GeV/n	6.0 7.0	5.0 7.5 3.0	15 to 200 15 to 200 15 to 200	50 to 150 50 to 150 50 to 150	100 100 100
B-68	Hall/Worgul	Fe, 1 GeV/n	2.5	3.0	NA	NA	50
B-69	Nelson	Fe, 1 GeV/n	2.5	1.0	500 to 5000	100 to 1000	100
B-71	Burns	Fe, 1 GeV/n	7.0	4.0	1 to 300	50-100	50
B-72	Gonda	Fe, 1 GeV/n	2.0	1.0	50 to 200	50-100	80
B-73	Sutherland	Fe, 1 GeV/n	2.0	3.5	1 to 300	50-100	50
B-74	Chatterjee	Fe, 1 GeV/n	4.0	2.0	30 to 150	50-100	20
B-75	Ford	Fe, 5 GeV/n	3.0	1.5	5 to 10	5	30
B-76	Green	Fe, 1 GeV/n	1.0	1.0	50 to 200	100	6
Totals	22		138 hr	146 hr	5 to 20000	20 to 1500	~2237

BNL-9 PARTICIPANTS, EXPERIMENTAL SAMPLES AND ENDPOINTS

Exp.	Participants	Samples	Endpoints
B-1	Heavy Ion Fragmentation and Transport in Matter C. Zeitlin (PI)	Solid state detectors	Heavy ion fragmentation CR39 calibration
B-3	Heavy Ion Induced Chromosome Damage and Biomedical Countermeasures F. Cucinotta/H. Wu (PI)	Human lymphocyte and human fibroblast (AG1522)	PCC chromosome damage Gene expression using SELDI Protein Chip System
B-7	Effects of Exposure to Heavy Ions. B. Rabin (PI)	Sprague-Dawley Rats	Neurological and neurochemical changes
B-44	Influence of the Shielding on the Space rad. Biological Effectiveness. M. Durante (PI)	Human cells embedded in agarose gel(plugs) Human lymphocytes in suspension in full medium	DNA damage and repair. Shielding effects.
B-45	Germ Cell Mutagenesis in Medaka Fish Following Exposure to HZE particle radiation R. Setlow (PI)	Male Medaka fish	Mutation induction
B-51	Particle-Ind. Telomere Loss in Human cells. J. Murnane (PI)	SC308H cells	Survival, mutation frequency, chromosomal changes and telomere status.
B-52	Effect of Deep Space Radiation on Human Hematopoietic Stem Cells. A. Gerwitz (PI)	TF-1 cells	DNA damage (DSB and clustered damages)
B-53	Nutritional Countermeasures to Radiation Exposure. J. Lupton (PI)	Sprague-Dawley rats	Gene expression, tumor incidence.
B-54	Screening of Agents for Protection Against Radiation Induced Oxidative Stress A. Kennedy (PI)	Sprague-Dawley rats Htori-3 human thyroid cells 10T1/2 mouse fibroblast cells	Cell transformation. Measure of oxidative stress (DCF). Antioxidant assays in collected tissues.
B-57	Microlesions in Membranes Induced by Heavy Ion Rad. J. Koniarek (PI)	Phosphatidylcholine vesicles dye-filled	Florescence signal.
B-62	Differential Cognitive, Behavioral, and Biological Effects of Protons and ⁵⁶ Fe Irradiation of the Rat Brain A. Obenaus (PI)	Sprague-Dawley rats	Behavioral Testing: Radial Arm Maze and Morris Water Maze
B-63	Radiation Induced Gene Expression Profile in C57Bl/6 Mice G. Nelson (PI)	C57Bl/6 Mice	Gene Expression using microarray analysis.
B-64	Risk Assessment and Chemoprevention of HZE-Induced CNS Damage M. Vazquez (PI)	NT2 human neural stem cells, oligodendrocytes	Survival, apoptosis, gene expression.
B-65	CNS Damage and Countermeasure M. Vazquez (PI)	C57Bl/6 Mice	Behavioral Testing: Locomotor activity and Morris Water Maze. Neurochemistry.

Exp.	Participants	Samples	Endpoints
B-68	Hall/Worgul (PI)	C57Bl/6 wild type mice C57Ml/6 ATM mutant	Cataract induction
B-69	Mutation & Chromosome Aberration in the Nematode <i>C. elegans</i> following Irradiation with Relativistic Charged Particles G. Nelson (PI)	Nematode <i>C. elegans</i>	Mutation and chromosome aberrations.
B-71	Selective Inhibition of 56Fe carcinogenesis by Dietary Retinod F. Burns (PI)	Sprague-Dawley Rats	Skin tumor induction and modulation by dietary retinyl acetate.
B-72	Comparison of Cell and Tissue 3D Models for Assessment of Genotoxic Damage by High Energy Charged Particles. S. Gonda (PI)	Normal & Transgenic fibroblast cells Normal & Transgenic epithelial cells	Mutation types and frequency induced in target genes at molecular level.
B-73	DNA Damage Clusters in low level radiation responses of Human Cells B. Sutherland (PI)	T7 and in Human DNA human cells (28SC monocytes)	Bistranded Clustered DNA Damages
B-74	Predicted and Observed Dose-responses for Simple and Complex Chromosomal Aberrations after Exposure of Human Cells to HZE Radiations: Effects of Beam Filtration. A. Chatterjee (PI)	GM2149 Normal human fibroblast cell cultures	Chromosomal aberrations.
B-75	Low dose response of respiratory cells in intact tissue and reconstituted J. Ford (PI)	Tracheal tissue explants.	Apoptosis and bystander effects
B-79	Radiobiology of thyroid follicular cells. L. Green (PI)	3D Thyroid cells cultures	Gene expression alterations

List of personnel that participated in the planning, organization and execution of BNL-8 run

BNL Management:

- Laboratory Director: **Peter Paul**
- Associate Director for High Energy and Nuclear Physics: **Tom Kirk**
- Associate Laboratory Director for Life Sciences: **Nora Volkow**

NASA Management:

- Headquarters: **Walter Schimmerling**
- JSC: **Frank Cucinotta**

Scientific Advisory Committee:

- **Betsy Sutherland** (Chair), BNL
- **Louis Pena**, BNL
- **Richard Setlow**, BNL
- **Joel Bedford**, CSU
- **Les Braby**, PNL
- **Charles Geard**, Columbia University
- **Kathryn Held**, Massachusetts General Hospital

Collider Accelerator Department-AGS

- Chairman: **Derek Lowenstein**
- Deputy Chairman: **W.T. Weng**
- Associate Chair of Operations: **A.J. McNerney**
- Experimental Planning and Support Head: **Philip Pile**
- Associate Chair for ESHQ: **Ed Lessard**
- ESHQ Division Head: **Ray Karol**
- ESH Coordinator: **Asher Etkin**
- Facility Support Representative: **Chuck Schaefer / Henry Kahnhauser**
- Environmental Coordinator: **Joel Scott**
- Training and Procedures Manager : **John Maraviglia**
- Main Control Room: **Peter Ingrassia**
- Work Control Manager: **Peter Cirnigliaro**
- BNL Laser Safety Officer: **Chris Weilandics**
- Experimental Safety Review Committee: **Yousef Makdisi (Chair)**
- Radiation Safety Committee: **Dana Beavis (Chair)**
- Accelerator Safety Review Committee: **Woody Glenn (Chair)**
- ALARA Committee: **Chuck Schaefer (Chair)**
- Associate Chair for ES&H/Q.A: **E. Lessard**
- Accelerator Division Head: **Thomas Roser**

- Chief Electrical Engineer: **J. Sandberg**
- Chief Mechanical Engineer: **J. Tuozzolo**
- Accelerator Physicist lead by: **Leif Aherns**
- Tandem Group leader: **Peter Thieberger**
- Physics Support: **Yusef Makadisi**
- CAD Components and instrumentation support: **David Gassner**
- AGS Radiation Safety Committee: **Ken Reece**
- C-A Dept Training Manager: **John Maraviglia**
- AGS Control Section lead by: **Don Barton**
- Liaison Engineering Group lead by: **David Phillips**
- Liaison physicist: **Adam Rusek**
- RHIC&AGS Users Center: **Susan White-DePace, Angela Melocoton**
- Mechanical Service Technicians led by: **Fred Kobasiuk**
- Survey Group led by: **Frank Karl**
- Beam Service Technicians led by: **Paul Valli**
- Electronic Service Technicians led by: **Bill Anderson**
- AGS Instrumentation Group led by: **Pete Stillman**
- AGS Main Control Room and Operations led by: **Pete Ingrassia**
- Health Physics Group led by: **Chuck Schaefer**
- AGS Electricians led by **Bill Softye**
- AGS Riggers led by: **Nick Cipolla**
- Carpenter and Welder Support Service and Technical Support led by: **Roger Hubbard**

Medical Department:

- Dept. Chair: **John Gatley**
- Medical Liaison: **Marcelo E. Vazquez**
- Building manager: **W. Gunther**
- Administration: **Denise White and Donna Russo**
- Animal Care Facilities: **Maryann Kershaw, Kerry Bonti, Chris Risland.**
- Technical support: **Opal Thomas, Katherine Conkling, Bae Pyatt**
- Training Coordinator: **Ann Emrick**
- **RCD**
 - **Kay Conkling**
 - **Dennis Ryan**
 - **Deana Buckallew**
 - **Jim Williams**
 - **Bob Colichio**

Plant Engineering:

- BLAF Custodian, **P. Abrams**
- Plumbers: **B. McCafferty**
- Painters/Carpenters: **B. Laakmann**
- Electricians: **T. Baldwin**

Biology Department:

- Chairman: **Carl Anderson**
- **Betsy Sutherland**
- Cesium Source Manager: **Richard Satkulis**

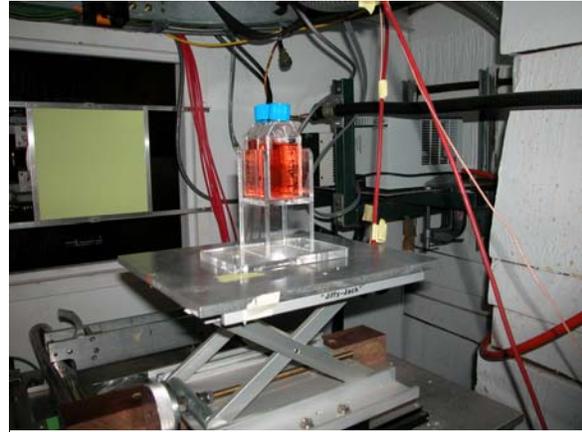
Lawrence Berkeley National Laboratory:

- **Jack Miller**
- **Lawrence Heilbronn**
- **M. Nyman**
- **R. P. Singh**
- **W. Holley**

BNL-9 PICTORIAL



Optical Bench at the AGS A-3 beam line.



Samples positioned for heavy ion exposure



Adam Rusek (BNL) adjusting the universal sample platform..



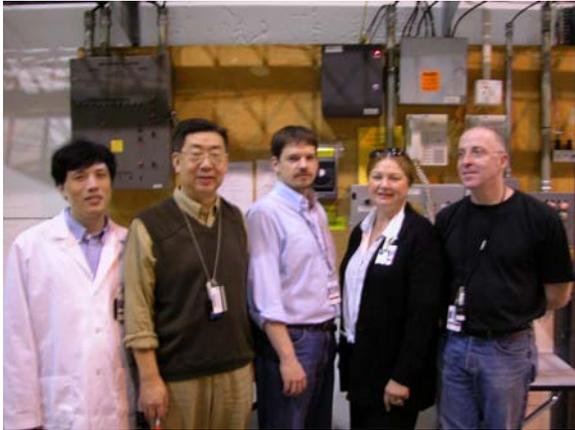
Peter Guida (BNL) exchanging samples.



Marco Durante preparing cells at the Medical Dept. (LTSF)



Frank Sulzman (NASA) and Bill Holley (LBNL) at the NASA trailer.



Dr. Ann Kennedy (U. Penn) and team members at the AGS floor.



Nancy Turner (TAM) and Dr. Lupton' (NSBRI) crew at the AGS floor.



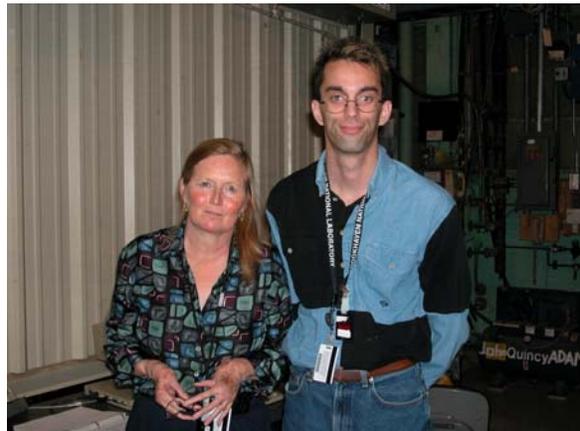
Dr. Gregory Nelson observing worms at the Medical Dept. (LTSF)



Dr. Les Braby manning an AGS workstations at the AGS floor.



Donal Lazarus (BNL), A. Smith (LLUMC) and I-Hung Chiang (BNL) relaxing at the



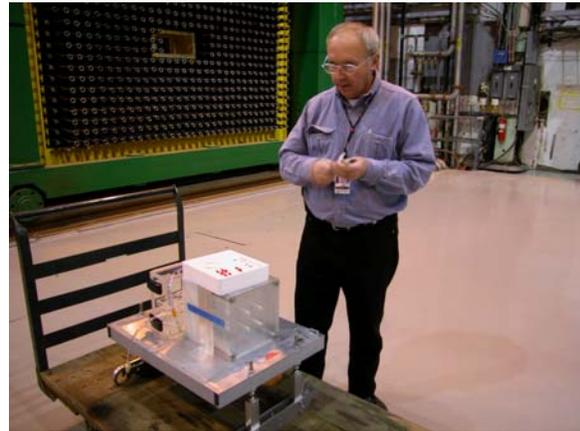
Dr. Lora Green and B. Bianski (LLUMC) at the AGS floor.



Panoramic view of the CAD-AGS Main Control Room (MCR).



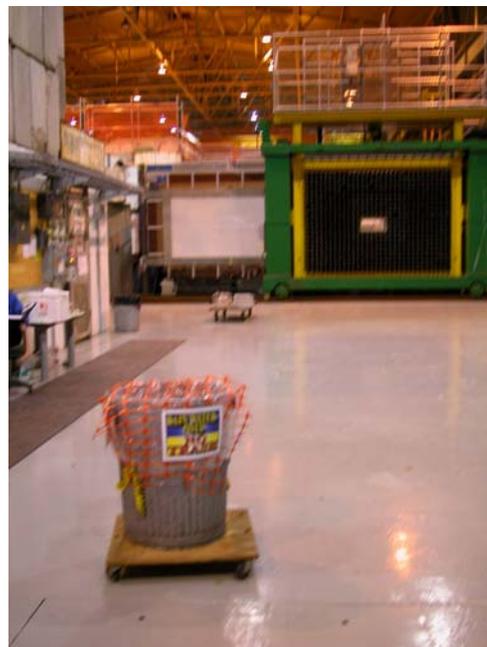
Dr. Dick Setlow (BNL) and Jim Jardine (BNL) inside the animal room at the NASA trailer.



Dr. Jan Koniarek (Columbia U.) preparing samples to be exposed at the A-3 beam line..



View of the A-3 line gate access control station at MCR.



Building 912. Farewell AGS....